CHAPTER 640 – COMPOSITE PAVEMENTS

Topic 641 – Types of Composite Pavement

Index 641.1 – Asphalt Over Concrete Pavement

This configuration consists of an asphalt layer over concrete surface layer (typically jointed plain concrete pavement or continuous reinforced concrete pavement).

The asphalt layer can be designed to provide structural value or to address functional goals for the pavement surface (asphalt layers over lean concrete base or cement treated base are called semi-rigid pavement, and are considered to be flexible pavements for the purposes of this manual). For new composite pavement, the primary function of the asphalt layer is to act as a thermal and moisture blanket to reduce the vertical temperature and moisture gradients within the underlying concrete layer and decrease the deformations caused by curling and warping of concrete slabs caused by those gradients.

Asphalt over concrete composite pavements are found most often where older pavements that have had asphalt overlay such as hot mix asphalt, open graded friction course, or rubberized hot mix asphalt, placed over previously built jointed plain concrete pavement (JPCP) or continuously reinforced concrete pavement (CRCP.) New or reconstructed composite pavements consisting of asphalt layer over JPCP or CRCP typically have not been built in the past on State highways. Reasons include the typical need to replace the surface of flexible pavements more frequently than the need to recondition the surface of rigid pavements and the fact that current design methods do not consider the effects of reduced thermal and moisture gradients from an asphalt overlay in concrete thickness design. Some cases in which the asphalt over concrete composite pavement option is used include:

- To match the existing pavement structure when widening;
- When adding truck lanes to an adjacent flexible pavement;
- To provide a nonstructural surface course to an existing rigid pavement that is still structurally sound but is rough or has other surface conditions needing attention.

Thin flexible layers (i.e. sacrificial wearing course) that are 0.25 foot thick or less have sometimes been placed over JPCP or CRCP to improve the ride quality or friction of the rigid layer and to reduce tire/pavement noise. Because ride quality and friction can also be improved by diamond grinding or grooving the existing concrete layer, the Engineer should perform a life-cycle cost analysis (LCCA) to determine if diamond grinding/grooving or an asphalt nonstructural overlay is the most cost effective before deciding which option to select.

641.2 Concrete Over Asphalt Pavement

This is generally not considered composite pavement. This type of pavement is discussed in Chapter 620.

Topic 642 – Engineering Criteria

642.1 Engineering Properties

The engineering properties found in Index 622.1 for rigid pavement and Topic 631 for flexible pavement apply to composite pavements and are considered in the ME design methods for flexible overlays on rigid pavement and rigid overlays on flexible pavement. Care should be taken in selecting asphalt materials specifically to slow reflective crack propagation from joints and cracks in the underlying concrete layer when using thin asphalt overlays for preservation and CAPM overlays.

642.2 Performance Factors

Flexible layers placed over rigid surface layers need to be engineered and use materials that will meet the following requirements:

(1) Reflective Cracking. Joints or cracks from the underlying concrete surface layer should not reflect through the asphalt layer during the service life of the composite pavement.

(2) Smoothness. The asphalt layer should be engineered to provide an initial MRI meeting the requirements of construction smoothness specifications and maintain an MRI that is less than 170 inches per mile through its design life.

(3) Bonding. A major factor in the service life of the composite pavement is the condition of the bond between the asphalt layers, and between the asphalt and concrete layers. Flexible layers on concrete need a good bond to the concrete and between each asphalt lift regardless of their thickness, as bonding plays an important role in the service life of the overlay. To achieve the maximum bond between asphalt and concrete layers, consult the District Materials Engineer or Headquarters Office of Asphalt Pavement for options on effective bonding methods.

642.3 Overlay Limits

On overlay projects, the entire traveled way and paved shoulder shall be overlaid. Not only does this help provide a smoother finished surface, it also benefits bicyclists and pedestrians when they need to use the shoulder.

Topic 643 – Engineering Procedures for New Construction and Reconstruction

643.1 Mechanistic-Empirical Design Method

As with all new pavement decisions, LCCA should be used to determine whether the composite pavement is more cost effective over the analysis period than asphalt or concrete pavement alternatives.

Topic 644 – Engineering Procedures for Pavement Preservation

644.1 Preventive Maintenance

Preventive Maintenance is used to maintain the asphalt surface course layer or to replace thin asphalt layers (i.e., non-structural wearing courses) placed over the underlying concrete layer. Note: Thin asphalt overlays on concrete, less than 0.35 ft thick, which includes all preventive maintenance overlays, tend to have very short reflective cracking lives. If work is needed to repair the underlying concrete layer, it should be developed as a CAPM (Index 644.2) or roadway rehabilitation (Topic 645) project. Additional information on preventive maintenance of the asphalt layer of a composite pavement is the same as for the flexible pavements, which can be found in the "Maintenance Technical Advisory Guide (MTAG)" available on the Department Pavement *website (https://dot.ca.gov/programs/maintenance/pavement/asphalt-pavement).*

644.2 Capital Preventive Maintenance (CAPM)

The CAPM warrants for concrete and asphalt pavements in Index 624.2 and 634.2 apply to composite pavements. The procedures and designs for asphalt over concrete composite pavement CAPM projects are the same as those for flexible pavements (see Index 634.2) except that instead of digouts concrete slab replacement and/or base repair may be required.

The roadway rehabilitation requirements for overlays and preparation of existing pavement surface for CAPM projects are discussed in Index 645.1. Additional details and information regarding CAPM policies and strategies can be found in Index 603.3, and Design Information Bulletin 81 or current DIB "Capital Preventive Maintenance Guidelines".

Topic 645 – Engineering Procedures for Pavement Rehabilitation

645.1 General Considerations

For additional information on rehabilitation of composite pavement with rigid surface courses refer to the Concrete Pavement Guide available on the Department Pavement website.

Asphalt overlays on existing concrete pavement (crack and seat) are designed using CalME. The following preparatory activities should be included in projects for asphalt overlay of existing concrete pavement and asphalt overlay on existing asphalt over concrete composite pavement:

(1) Ride Quality (Smoothness). When the smoothness of the existing roadway is greater than 170 inches per mile as measured by the Mean Roughness Index (MRI), the minimum thickness should be 0.25 foot of HMA or consisting of 0.10 foot HMA followed by a minimum of 0.15 foot RHMA surface course layer as applicable. A nonstructural open-graded wearing course may be placed on the top lift. Note that in some cases the existing pavement will need to be repaired to assure the roadway smoothness will remain below 170 inches per mile throughout the life of the overlay.

(2) Preparation for Placing Asphalt Layer Over Existing Concrete Pavement.

Existing concrete slabs should generally be subjected to crack and seat procedures following Section 30 of the standard specifications. Undesirable material such as excessive crack sealant should be removed before paving. Existing thermoplastic traffic striping and raised pavement markers should also be removed. Spalls in joints and cracks should be repaired. Shattered slabs and corner cracks that exhibit pumping or have become punchouts in JPCP should be replaced, and punchouts in CRCP should be repaired. A leveling course and pavement interlayer are required for structural asphalt overlays on concrete pavement. The leveling course is 0.1 ft if the TI in the design lane is less than 12 and 0.15 ft if the TI in the design lane is greater than or equal to 12. The "asphalt impregnated fabric interlayer" is placed on the interlayer. The leveling course and interlayer are not considered part of the structural design when using CalME. Truck traffic on the leveling course prior to placement of the structural layers should be minimized to limit damage to the leveling course.

Guidance on evaluation of existing concrete pavements for asphalt overlay are included in the Site Investigation Guide.

(3) Preparation for Placing Asphalt Layer Over Existing Asphalt on Concrete Composite Pavement.

Existing non-structural wearing courses should be removed and, if needed, underlying pavement repaired prior to placing a new asphalt wearing course. In general, any existing asphalt materials that have poor bonding between lifts, moisture damage, or other concerns that may harm the performance of the new asphalt overlay should be removed. Leaving less than 0.2 foot of existing structural HMA before placing the new asphalt

overlay should also be evaluated for cost-effectiveness if there are concerns that it will be rough after milling. A 0.2 foot layer provides a smoother riding surface after milling because of uncertainty of the condition of the underneath concrete pavement surface when used as a riding surface during construction.

Existing pavement distresses should be repaired before overlaying the pavement. Cracks wider than 3/8 inch should be sealed or repaired. Undesirable material such as excessive crack sealant should be removed before paving. Existing thermoplastic traffic striping and raised pavement markers also should be removed. Loose asphalt wearing course should be removed and replaced, and potholes and localized failures in the underlying concrete repaired. Corner punchouts and shattered slabs in the underlying JPCP that will impact the smoothness of the new asphalt overlay should be repaired. Punchouts in underlying CRCP should be repaired before overlay for the same reason.

645.2 Mechanistic-Empirical Design Method

For information on Mechanistic-Empirical Design and requirements, see Index 604.2.

When engineering a flexible overlay over existing JPCP, follow Index 635.2 for pavement design. Identify the existing JPCP layer as cracked in the CalME analysis.

When engineering a flexible overlay over existing CRCP, follow Index 635.2 for pavement design assuming that the CRCP is JPCP. Identify the existing CRCP layer as cracked in the CalME analysis.

There are different design procedures for the design of concrete overlays on asphalt pavement. One method uses concrete overlays with a minimum 0.65 foot thickness requirement, which are engineered similar to new concrete pavement according to the standards and procedures for rigid pavements in Chapter 620. The Department is developing design methods and engineering standards for thinner concrete overlays (0.35 to 0.60 foot) on existing asphalt pavement which are also discussed in Chapter 620; contact the Office of Concrete Pavement for further information.